

Fracking in Colorado: Evidence, politics and policy change

COMMUNICATION | EDITORIAL | INVITED CONTRIBUTION | PERSPECTIVE | REPORT | REVIEW

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ABSTRACT

This communication examines fracking (an abbreviation for hydraulic fracturing) in Colorado, analysing the degree of alignment between problem definition, data and evidence, political narratives, and policy interventions, among stakeholders (including government, industry and environmental groups). The risks associated with fracking emerged as a policy problem in 2011 following increased fracking-related complaints in Colorado. After assessing the pattern of complaints, the government identified that fracking concerns were driven by a ‘fear of the unknown’, propagated by environmental groups, not by data and evidence on actual impacts. The state government intervened by establishing three key fracking-related regulations: Rule 205A (2011) requiring disclosure of chemicals used in the fracking process, Rule 604 (2013) extending distances of fracking operations from building and public facilities, and Rule 609 (2013) on stricter groundwater monitoring. At the start of the policy process, the varying political narratives on fracking did not align with existing data and evidence. However, after a series of deliberations between the government, industry, and environmental groups, stakeholders in Colorado reached a common agreement on policy interventions that eventually aligned with the basic problem definition.

Introduction and scope of study

This paper focuses on Colorado’s major policy changes that occurred in response to fracking concerns in 2011 and 2012. This analysis does not go into the debates on fracking-induced seismicity (or earthquakes) as it is beyond the scope of this research [1]; instead, the focus is on environmental and health impacts. Fracking in Colorado makes an interesting case for a policy analysis because it is a paradigmatic example of how frack-

ing reshaped energy production in the US. Oil production in Colorado stood at about 20-30 million barrels per year between 1990 and 2005. But after fracking took off in the early 2000s, Colorado’s production grew rapidly – reaching 177.8 million barrels in 2018 [2].

Fracking usually involves drilling an L-shaped wellbore cased with cement and steel, typically about two to three kilometers from the land surface. When the wellbore reaches the shale reserves, the casing is perforated using explosive

charges to create holes in the horizontal section of the casing. The actual fracking then occurs when a mixture of water (approximately 95%), sand (3% to 4.5%) and chemicals (0.5% to 2%) is pumped into the well under extremely high pressure. The fluid mixture runs through the casing and exits through the perforated horizontal sections into the shale rock. Sand particles in the fluid help in opening the shale rocks, while the chemicals help the oil and gas seep out back into the well casing. The fluids initially pumped into the well flow back out to the surface and are disposed of or treated. Then finally, the oil and gas is pumped back out of the well, from where it is transported for sale [3].

Fracking has undoubtedly reshaped the US and global energy landscape. The technique brought about the North American ‘shale boom’ in the early 2000s, enabling extraction of oil and gas previously unreachable using conventional methods [4]. Having both geological and technological advantages, the US seized the shale opportunity to increase its domestic energy production. For the first time since 1973, the US became a net exporter of energy in 2018, surpassing the likes of Saudi Arabia and Russia [5]. In reducing its dependence on foreign oil imports, the US was also able to strengthen both its energy security and reduce domestic energy [6].

Despite its transformative impact, debates on the costs and benefits of fracking in the US remain starkly polarised, as state governments have regulated fracking in varying ways prices [7]. It is rightly argued that fracking has deepened America’s reliance on fossil fuels and delayed transition to cleaner sources of energy, especially when compared to energy transition in the European Union

(EU) [6]. Citizens and environmental groups have pressured oil-producing states, including Colorado, Ohio, Oklahoma, and Texas, to implement stricter regulations on fracking [8]. Three states – Maryland, New York, and Vermont – went on to ban fracking [9]. But in the face of environmental push-back, fracking has continually increased across the main oil-producing states in the US [10].

Problem definition

In 2010, Colorado witnessed an increased number of fracking-related complaints to state and local government authorities. The complaints were triggered by three factors. Firstly, fracking operations began to increasingly migrate from sparsely populated areas towards new oil and gas discoveries in more densely populated areas (near parks, schools, and residential areas) around 2010 to 2011 [11]. The added visibility of oil and gas operations in Colorado contributed to increased complaints. Secondly, the Deepwater Horizon spill spotlighted environmental risks of oil and gas extraction and sparked public debate on fracking in Colorado and the US at large. Third, the release of *Gasland* in 2010, an anti-fracking documentary that popularised images of dangers associated with fracking,¹ triggered many residents to advocate against fracking [15]. By 2011, media attention and public complaints on fracking in Colorado further spiked; *it became apparent that the government needed to intervene*.

The Colorado government detected a mismatch between the problem definition (Table 1) and evidence. In analysing the nature of complaints, the government observed that residents were driven

¹ *Gasland*, an award-winning HBO documentary on fracking, provides a classic example of how storytelling and images can influence problem definition in public policy. *Gasland* provided a window through which many Americans would understand the risks associated with fracking. The documentary showcased experiences of residents in proximity to fracking operations, by narrating health problems that the residents traced to air and water contamination. Notably, the documentary showed that pipe borne water in some fracking communities were contaminated with chemicals and water from taps would flame up when the host lights a match close to the faucet [12]. It was no coincidence that policy action in Colorado and three other fracking states happened a year after the release of *Gasland*. Industry associations heavily criticised *Gasland* as ‘wildly inaccurate and irresponsible’ [13]. They argued that depth of oil reservoirs and water aquifers are thousands of feet apart, separated by impermeable rocks. Geologist further explained that any linkage between groundwater and oil would take hundreds or even millions of years to happen and is unlikely to be induced by fracking. An interdisciplinary report by MIT showed that the very rare incidents of water contamination caused by fracking were as a result of breach of existing regulations [14]. A rebuttal documentary called *FrackNation* was released in 2013, but did not attain *Gasland*’s popularity, nor did it help in re-shaping public views on fracking [15, 16].

Table 1: Problem definition on fracking in Colorado.

Problem definition	Fracking is risky and potentially harmful to public health and the environment.	
	INDUSTRY GROUPS	ENVIRONMENTAL GROUPS
Observed condition	The risks associated with fracking are being effectively managed. Incidents of pollution are as a result of bad practice, not because fracking is risky.	The risks associated with fracking outweigh the economic benefits because fracking is an inherently risky technique.
Desired condition	Fracking should continue (business as usual).	Fracking should be strictly regulated or banned.

by ‘fear of the unknown’, and not by actual impacts (or evidence) [17]. Indeed, the information gap between the industry and residents was a problem in itself. Environmental groups filled the information gap and were instrumental in shaping the debate on fracking at community level, essentially deepening existing distrust between communities and the oil industry [18, 19].

Data and Evidence on Causes and Consequences

Compelling research on the impacts of fracking on public health is only recently being documented. Several jurisdictions that have banned fracking, including the UK in November 2019, did so based on a so-called ‘precautionary principle’, aiming to avoid the *potential* risks of fracking altogether [20]. However, recent epidemiologic studies from John Hopkins University and the University of Pennsylvania showed that rates of hospitalisation were higher in areas with fracking activities, when compared with non-fracking communities [21, 22]. Similar studies in Colorado US have analysed the relationships between fracking and public health risks, but researchers are still yet to establish direct causal links [10, 23].

Despite the research gaps in the public health domain, there are known dangers associated with fracking. Out of the over 1,000 different chemicals used in the fracking process, about 75% are considered dangerous to human health [24]. The chemicals in fracking fluids (arsenic, formalde-

hyde, lead and mercury) are known to affect the nervous systems, cardiovascular systems, respiratory organs, and sensory organs (including the skin and eyes) [25]. Companies, however, argue that most of these chemicals only affect people upon direct exposure, which is highly unlikely for oil workers, and even more unlikely for residents. Environmental groups in Colorado oppose this view by arguing that the health risks for chemical toxins can take decades to manifest in persons affected and that health experts need time to confirm the dangers of fracking on residents [23]. Unlike health impacts, data and evidence on the environmental impacts of fracking are more readily available, as summarized in Figure 1.

Water pollution There are two ways fracking can potentially pollute groundwater. First, poorly constructed wells could lead to incidents where fracking fluids or oil and gas migrate into groundwater. Secondly, chemicals, oil, or gas could flow from the fracked shale rocks up into groundwater even when wells are perfectly cased [26]. But several geologic and hydrological studies have shown that the second risk is highly unlikely because shale oil and gas is well below groundwater layers and separated by rock [27]. According to Colorado’s oil sector regulator, oil and gas companies in Colorado reported 516 cases of spills or releases between 2013 and 2017, but none of the spillages affected public water systems [28].

Air pollution When oil and gas flow out of wells, most of the gas (in form of methane) is captured. But there are cases where methane (which traps more than 20 times more heat than CO₂ in

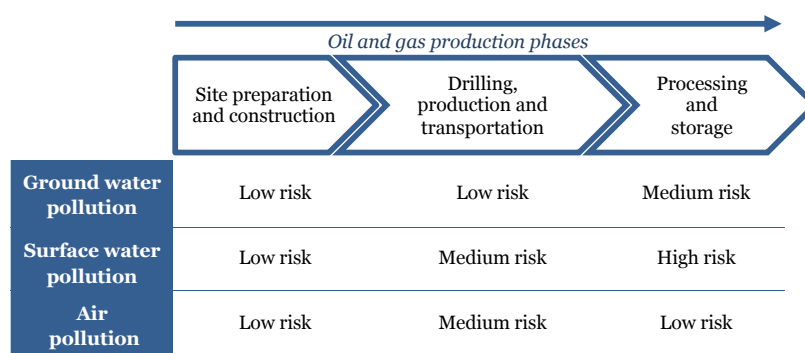


Figure 1: Pollution risk matrix.

the atmosphere) and other chemical gases such as benzene, escapes into the atmosphere during explosions or leak out of gas pipelines. These gases have strong greenhouse effects and pose health risks (such as asthma and skin disorders) upon direct or indirect exposure [22]. A 2017 study using data from Colorado's environmental agency found that in 10 years, there were 116 fracking-related explosions in Colorado [29]. At an incidence rate of one in 3,700 active wells, air pollution risks are generally low by regulatory standards [28].

Political Narratives

Environmental Groups When fracking became a major policy issue in 2010, environmental groups downplayed the economic gains of fracking and focused on the health and environmental risks. Their political narrative combined 'stories of power' with 'stories on change' [30]. The 'change' narrative depicted the negative impacts associated with fracking, such as air pollution and water contamination. The 'stories of power' portrayed the government and companies as conspirators in environmental injustices. They argued that the governments and companies are aware of the risks associated with fracking, but kept it secret to maintain economic gains [31].

Industry Groups As shown in Figure 2 below, the industry groups showed low interest in addressing environmental concerns. However, as companies became more aware of the negative perceptions associated with fracking, they communicated that with proper regulation and safety measures, most of the risks associated with frack-

ing can be effectively mitigated [32]. Companies explained that fracking has been used in Colorado for over 40 years and that the process is engineered to ensure the safety of the environment and public health. To put the fracking process in context, an oil company once published that fracking occurs in depths about 10 times the tallest building in Denver, Colorado (7,000 ft.) [33]. Such descriptions aimed to allay fears that fracking occurs near aquifers.

State Government At the state level, fracking enjoyed bipartisan support in Colorado since the technique become widespread in the early 2000s. Governor John Hickenlooper, a former geologist and oil worker, was Governor of Colorado at the height of the fracking debate. The governor was an ideal 'man in the middle' because he was able to productively engage in the technical and non-technical discourse on fracking [34]. During Governor Hickenlooper's time in office from 2011 to 2019, the government actively supported fracking. In fact, Governor Hickenlooper went as far as appearing on industry-sponsored advertisements [35]. Even though Governor Hickenlooper's pro-fracking stance was sometimes criticised in the media, he generally enjoyed strong public support in Colorado, having previously served as Mayor of Denver from 2003 to 2011 [36].

Fracking is good for the country's energy supply, our national security, our economy, and our environment.

- Gov. John Hickenlooper [33]

Local Governments The political narratives at local government levels are remarkably different from that of the state government. Local governments do not have strong incentives to support fracking because they do not benefit from corporate taxes paid by companies, but they are left to deal with negative externalities [37]. Longmont and Fort Collins went on to ban fracking at the county level in 2012 and 2013 respectively [38]. The ban brought about legal controversies that resulted in a Colorado Supreme Court decision to reverse fracking bans imposed by both local authorities, and effectively limited the authority of local governments to impose environmental regulations that go against laws by the State of Colorado [39].

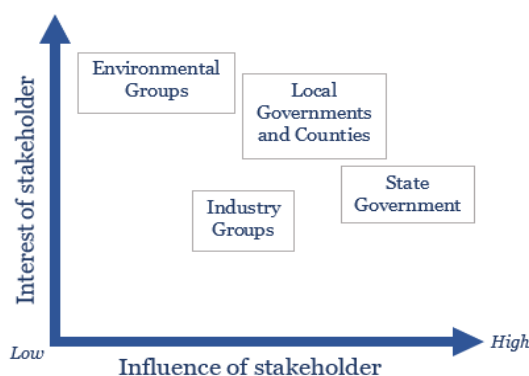


Figure 2: Stakeholder map showing level of interest and influence on fracking-related environmental impacts.

Policy Interventions

The Colorado Oil and Gas Conservation Commission (COGCC) has regulated environmental externalities of oil and gas activities in Colorado since its establishment in 1951. With the proliferation of fracking in the early 2000s, COGCC was drawn into the debate on fracking. COGCC approached fracking in a cautious and incremental manner, recognizing that even though fracking was controversial, compelling evidence on its impacts were still being researched and documented.

Colorado's policy process on fracking benefitted from legislative amendments to the Colorado Oil and Gas Conservation Act (COGCA) and the Colorado Habitat Stewardship Act (CHSA) in 2007 [40]. These amendments introduced deliberative and collaborative rule-making procedures

on environmental matters and allowed citizens or interested parties to file regulatory applications to COGCC [36]. Aside from the COGCA and CHSA amendments, Colorado handled fracking mainly as a regulatory issue via the COGCC, ensuring that specific regulations did not go through the Colorado legislature [41].

Following deliberative processes between the government, industry groups and environmental group, from 2010 to 2013, the COGCC established the three main regulations in response to fracking:

Rule 205A: Hydraulic Fracturing Chemical Disclosure (2011) [42] – The regulation requires companies to publicly disclose the types of chemicals, concentrations of chemical additives, and quantity of water used in fracking. The disclosure rule does not cover chemicals that are considered trade secrets, unless in situations where public health experts or regulators demand such proprietary information. Companies were mandated to publish the information on *FracFocus.org* to ensure transparency of operations.

Rule 604: Setback and Mitigation Measures for Oil and Gas Facilities, Drilling, and Well Servicing Operations (2013) [43] – This regulation addressed concerns about locating oil and gas drilling operations near homes, schools, parks, and other public facilities. Rule 604 now ensures that drilling cannot occur less than 500 ft (152.4 metres) from any building units, and not less than 1,000 (304.8 metres) ft from high-occupancy buildings. Under this regulation, companies are also required to conduct site-specific assessments prior to any drilling activities and ensure that any risks to public health or the environment are effectively mitigated.

Rule 609: Groundwater Baseline Sampling and Monitoring (2013) [44] – This regulation mandates testing of groundwater for toxins at various stages of well development. Even though Colorado already had some localised groundwater testing rules, Rule 609 brought about a more comprehensive groundwater-monitoring program. For baseline water assessment, companies must collect samples of groundwater from within 800 m of the well. Companies will then test for contamination

within six months to one year of commencing production, and then after 5 to 6 years to check for short or long-term contamination of groundwater.

Conclusion

The enactment of Rules 205A, 604, and 609 were considered victories by both the government, industry associations, and environmental groups. Outlined below are key factors that occasioned policy change on fracking in Colorado, and ensured policy alignment:

Regulatory approach The state government wisely calculated that it would be better to find a regulatory solution to the fracking issue else it could become politicised. This was especially crucial for Rule 205A which was passed in the run-up to Colorado's 2012 elections. The rationale for finding a regulatory solution was to avoid a situation where the fracking would enter the state legislature's agenda and become politically divisive to the detriment of evidence-based decision-making [36].

Policy entrepreneurship Former Colorado Governor, John Hickenlooper is considered a policy entrepreneur [45] because his political messaging assured residents that with strong regulation fracking was safe and economically beneficial to the state (primarily in tax revenue and job creation). The former governor also played an instrumental role in building trust between the industry and residents, by encouraging industry groups to disclose chemicals used in the fracking process to demonstrate beyond doubt that their chemicals are not harmful to the environment [34].

Policy diffusion Experiences from other oil-producing states influenced Colorado's rules on fracking, in line with political theory on 'policy diffusion'. Policy diffusion happens when policy choices in a given area is influenced by that of other jurisdictions [46]. Between 2010 and 2011, industry groups in Arkansas and Texas reached fracking disclosure agreements with environmental groups [37]. Therefore, Colorado also benefited from the existence of disclosure models and found ways to adapt the rules to the state's geology, geography, and residential characteristics.

Analysis of Colorado's fracking policies shows that environmental and industry groups altered their views on fracking over time. As the policy process progressed, environmental interests increasingly converged and stakeholders established some common understanding to facilitate policy change [41]. For example, the misinformation that fracking poisoned underground water was later revised by environmental groups [36]. On the industry side, companies relaxed their position on setbacks and chemical non-disclosure, realizing that keeping chemical compositions as trade secrets only worsened public perceptions on fracking [38]. For this reason, *it is plausible to conclude that the policy interventions aligned to a great extent with the problem definition and available evidence on fracking.*

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Conflict of interest The Author declares no conflict of interest.